Amendments to the Claims:

The following listing of claims will replace all prior versions, and listings, of claims in the application:

1-18. (Canceled)

19. (Previously Presented) An optical integrator, comprising:

an integrally formed plurality of first minute refraction surfaces; and

an integrally formed plurality of second minute refraction surfaces, which are provided closer to a light emission side than the plurality of first minute refraction surfaces so that the plurality of second minute refraction surfaces optically correspond to the plurality of first minute refraction surfaces, wherein

a parameter β satisfies the following conditions:

$| \beta | < 0.2$ (where $\beta = (\gamma -1)^3 \cdot NA^2/\Delta n^2$), where

a refracting power ratio $\varphi a/\varphi b$ between φa, a refracting power of the first minute refraction surfaces and φb, a refracting power of the second minute refraction surfaces is γ, numerical aperture on the emission side of the optical integrator is NA, and a difference between a refraction index of a medium on a light entrance side of the second minute refraction surfaces and a refraction index of a medium on a light emission side of the second minute refraction surfaces is Δn.

20. (Previously Presented) The optical integrator according to claim 19, wherein the plurality of first minute refraction surfaces and the plurality of second minute refraction surfaces are formed on the same optical member.

21. (Previously Presented) The optical integrator according to claim 20, wherein the plurality of second minute refraction surfaces comprise aspherical surfaces.

22.   (Previously Presented) The optical integrator according to claim 19, comprising:

a first optical member having the plurality of first minute refraction surfaces; and

a second optical member having the plurality of second minute refraction surfaces arranged on a light emission side of the first optical member.

23.   (Previously Presented) The optical integrator according to claim 22, wherein the plurality of second minute refraction surfaces comprise aspherical surfaces.

24.   (Previously Presented) The optical integrator according to claim 19, wherein each minute refraction surface is formed spherically or aspherically.

25.   (Previously Presented) The optical integrator according to claim 24, wherein the aspherical surface is a rotational symmetry aspherical surface or a rotational asymmetry aspherical surface.

26.   (Previously Presented) The optical integrator according to claim 19, which is used for an exposure apparatus, wherein a mask and a photosensitive substrate are relatively moved in relation to the projection optical system along a scanning direction, and thereby a pattern of the mask is projected and exposed on the photosensitive substrate, wherein

an absolute value of the parameter β in terms of a direction optically approximately perpendicular to the scanning direction is set lower than an absolute value of the parameter β in terms of the scanning direction.

27.   (Previously Presented) An illumination optical device for illuminating an irradiated surface, comprising:

the optical integrator according to claim 19.

28.   (Previously Presented) The illumination optical device according to claim 27, wherein the optical integrator forms a light intensity distribution in a given shape in an illumination region.

29.   (Previously Presented) An exposure apparatus, comprising:

the illumination optical device according to claim 27; and

a projection optical system for projecting and exposing a pattern of a mask arranged on the irradiated surface on a photosensitive substrate.

30.   (Previously Presented) The exposure apparatus according to claim 29, wherein

the pattern of the mask is projected and exposed on the photosensitive substrate by relatively moving the mask and the photosensitive substrate in relation to the projection optical system along a scanning direction, and wherein

an absolute value of the parameter β in terms of a direction optically approximately perpendicular to the scanning direction is set lower than an absolute value of the parameter β in terms of the scanning direction.

31.   (Previously Presented) An exposure method, comprising the steps of:

illuminating a mask through the illumination optical device according to claim 27, and

projecting and exposing an image of a pattern formed on the illuminated mask on a photosensitive substrate.

32.   (Previously Presented) The exposure method according to claim 31, wherein

the step of projecting and exposing an image of a pattern formed on the illuminated mask on a photosensitive substrate comprises the step of projecting and exposing the pattern of the mask on the photosensitive substrate while relatively moving the mask and

the photosensitive substrate in relation to the projection optical system along a scanning direction, and wherein

an absolute value of the parameter β in terms of a direction optically approximately perpendicular to the scanning direction is set lower than an absolute value of the parameter β in terms of the scanning direction.

33.   (Currently Amended) An optical integrator, comprising, in the following order from a light entrance side:

a first optical member having an integrally formed plurality of first minute refraction surfaces; and

a second optical member having an integrally formed plurality of second minute refraction surfaces, which are provided to optically correspond to the plurality of first minute refraction surfaces,

wherein the first optical member and the second optical member are separated by a space, that is filled with a gas, and

wherein a refraction index of an optical material forming the second optical member is set larger than a refraction index of an optical material forming the first optical member.

34.   (Previously Presented) The optical integrator according to claim 33, satisfying the following condition:

$0.05 \leq nb-na$, where

the refraction index of the optical material forming the first optical member is na, and the refraction index of the optical material forming the second optical member is nb.

35.   (Previously Presented) The optical integrator according to claim 34, which is used for light having a wavelength of 300 nm or less, wherein

the optical material forming the first optical member includes silica glass or fluorite, and wherein

the optical material forming the second optical member includes one material of magnesium oxide, ruby, sapphire, quartz crystal, and silica glass.

36.   (Previously Presented) The optical integrator according to claim 33, which is used for light having a wavelength of 300 nm or less, wherein

the optical material forming the first optical member includes fluorite, and wherein

the optical material forming the second optical member includes silica glass.

37.   (Previously Presented) The optical integrator according to claim 33, wherein

each minute refraction surface is formed spherically or aspherically.

38.   (Previously Presented) The optical integrator according to claim 37, wherein

the aspherical surface is a rotational symmetry aspherical surface or a rotational asymmetry aspherical surface.

39.   (Previously Presented) The optical integrator according to claim 33, which is used for an exposure apparatus, wherein a mask and a photosensitive substrate are relatively moved in relation to the projection optical system along a scanning direction, and thereby a pattern of the mask is projected and exposed on the photosensitive substrate,

wherein a parameter β satisfies the following conditions:

$|\beta| < 0.2$ (where $\beta = (\gamma -1)^3 \cdot NA^2/\Delta n^2$),

where a refracting power ratio $\varphi a/\varphi b$ between φa, a refracting power of the first minute refraction surfaces and φb, a refracting power of the second minute refraction surfaces is γ, a numerical aperture on the emission side of the optical integrator is NA, and a difference between a refraction index of a medium on a light entrance side of the second

minute refraction surfaces and a refraction index of a medium on a light emission side of the second minute refraction surfaces is Δn, and

wherein an absolute value of the parameter β in terms of a direction optically approximately perpendicular to the scanning direction is set lower than an absolute value of the parameter β in terms of the scanning direction.

40.   (Previously Presented) An illumination optical device for illuminating irradiated surface, comprising:

the optical integrator according to claim 33.

41.   (Previously Presented) The illumination optical device according to claim 40, wherein the optical integrator forms a light intensity distribution in a given shape in an illumination region.

42.   (Previously Presented) An exposure apparatus, comprising:

the illumination optical device according to claim 40; and

a projection optical system for projecting and exposing a pattern of a mask arranged on the irradiated surface on a photosensitive substrate.

43.   (Previously Presented) The exposure apparatus according to claim 42, wherein

the pattern of the mask is projected and exposed on the photosensitive substrate by relatively moving the mask and the photosensitive substrate in relation to the projection optical system along a scanning direction,

wherein a parameter β satisfies the following conditions:

$|\beta| < 0.2$ (where $\beta = (\gamma - 1)^3 \cdot NA^2/\Delta n^2$),

where a refracting power ratio φa/φb between φa, a refracting power of the first minute refraction surfaces and φb, a refracting power of the second minute refraction surfaces is γ, a numerical aperture on the emission side of the optical integrator is NA, and a

difference between a refraction index of a medium on a light entrance side of the second minute refraction surfaces and a refraction index of a medium on a light emission side of the second minute refraction surfaces is Δn, and

wherein an absolute value of the parameter β in terms of a direction optically approximately perpendicular to the scanning direction is set lower than an absolute value of the parameter β in terms of the scanning direction.

44.   (Previously Presented) An exposure method, comprising the steps of:

illuminating a mask through the illumination optical device according to claim 40, and

projecting and exposing an image of a pattern formed on the illuminated mask on a photosensitive substrate.

45.   (Currently Amended) The exposure method according to claim 44, wherein the step of projecting and exposing an image of a pattern formed on the illuminated mask on a photosensitive substrate comprises the step of projecting and exposing the pattern of the mask on the photosensitive substrate while relatively moving the mask and the photosensitive substrate in relation to the projection optical system along a scanning direction, wherein

a parameter β satisfies the following conditions:

$$|\beta| < 0.2 \text{ (where } \beta = (\gamma - 1)^3 \cdot NA^2/\Delta n^2),$$

where a refracting power ratio $\varphi a/\varphi b$ between φa, a refracting power of the first minute refraction surfaces and φb, a refracting power of the second minute refraction surfaces is γ, a numerical aperture on the emission side of the optical integrator is NA, and a difference between a refraction index of a medium on a light entrance side of the second minute refraction surfaces and a refraction index of a medium on a light emission side of the second minute refraction surfaces is Δn, and

wherein an absolute value of the parameter β in terms of a direction optically approximately perpendicular to the scanning direction is set lower than an absolute value of the parameter β in terms of the scanning direction.

46. (Previously Presented) An exposure apparatus, comprising:

an illumination optical system including an optical integrator; and

a projection optical system for forming a pattern image of a mask on a photosensitive substrate, wherein

the pattern of the mask is projected and exposed on the photosensitive substrate while the mask and the photosensitive substrate are relatively moved in relation to the projection optical system along a scanning direction, wherein

the optical integrator comprises: an integrally formed plurality of first minute refraction surfaces; and an integrally formed plurality of second minute refraction surfaces, which are provided closer to a light emission side than the plurality of first minute refraction surfaces so that the plurality of second minute refraction surfaces optically correspond to the plurality of first minute refraction surfaces, and wherein

a parameter β satisfies the following conditions:

$$| \beta | < 0.2 \text{ (where } \beta = (\gamma - 1)^3 \cdot NA^2/\Delta n^2), \text{ where}$$

a refracting power ratio φa/φb between φa, a refracting power of the first minute refraction surfaces in terms of a non-scanning direction optically approximately perpendicular to the scanning direction and φb, a refracting power of the second minute refraction surfaces in terms of the non-scanning direction is γ, numerical aperture on the emission side in terms of the non-scanning direction of the optical integrator is NA, and a difference between a refraction index of a medium on a light entrance side of the second minute refraction surfaces and a refraction index of a medium on a light emission side of the second minute refraction surfaces is Δn.

47.   (Previously Presented) An exposure method, comprising the steps of:

illuminating a mask through the illumination optical device including an optical integrator, and

projecting and exposing an image of a pattern formed on the illuminated mask on a photosensitive substrate, wherein

the step of projecting and exposing an image of a pattern formed on the illuminated mask on a photosensitive substrate comprises the step of projecting and exposing the pattern of the mask on the photosensitive substrate while relatively moving the mask and the photosensitive substrate in relation to the projection optical system along a scanning direction, wherein

the optical integrator comprises: an integrally formed plurality of first minute refraction surfaces; and an integrally formed plurality of second minute refraction surfaces, which are provided closer to a light emission side than the plurality of first minute refraction surfaces so that the plurality of second minute refraction surfaces optically correspond to the plurality of first minute refraction surfaces, and wherein

a parameter β satisfies the following conditions:

$$|\beta| < 0.2 \text{ (where } \beta = (\gamma - 1)^3 \cdot NA^2/\Delta n^2), \text{ where}$$

a refracting power ratio $\varphi a/\varphi b$ between φa, a refracting power of the first minute refraction surfaces in terms of a non-scanning direction optically approximately perpendicular to the scanning direction and φb, a refracting power of the second minute refraction surfaces in terms of the non-scanning direction is γ, numerical aperture on the emission side in terms of the non-scanning direction of the optical integrator is NA, and a difference between a refraction index of a medium on a light entrance side of the second minute refraction surfaces and a refraction index of a medium on a light emission side of the second minute refraction surfaces is Δn.

48.   (Previously Presented) A device manufacturing method comprising:

exposing a photosensitive substrate with the exposure method according to

claim 31; and

developing the photosensitive substrate.

49.   (Previously Presented) A device manufacturing method comprising:

exposing a photosensitive substrate with the exposure method according to

claim 47; and

developing the photosensitive substrate.

50.   (Previously Presented) An exposure method comprising:

introducing a radiation from a source to a plurality of first minute refraction

surfaces which are integrally formed on a first member of an optical integrator;

introducing a radiation from the first minute refraction surfaces to a plurality

of second minute refraction surfaces which are integrally formed on a second member of the

optical integrator, and which optically correspond to the plurality of the first minute

refraction surfaces;

illuminating a pattern with a radiation from the optical integrator; and

projecting a pattern image on a photosensitive substrate while moving the

photosensitive substrate along a scanning direction,

wherein a parameter β satisfies the following conditions:

$|\beta| < 0.2$ (where $\beta = (\gamma - 1)^3 \cdot NA^2/\Delta n^2$),

where a refracting power ratio $\varphi a/\varphi b$ between φa, a refracting power of the

first minute refraction surfaces in terms of a non-scanning direction optically approximately

perpendicular to the scanning direction and φb, a refracting power of the second minute

refraction surfaces in terms of the non-scanning direction is γ, a numerical aperture on the

emission side in terms of the non-scanning direction of the optical integrator is NA, and a

difference between a refraction index of a medium on a light entrance side of the second minute refraction surfaces and a refraction index of a medium on a light emission side of the second minute refraction surfaces is Δn.

51.   (Previously Presented) A device manufacturing method comprising:

exposing a photosensitive substrate with the exposure method according to claim 50; and

developing the photosensitive substrate.

52.   (Currently Amended) An exposure method comprising:

introducing a radiation from a source to a plurality of first minute refraction surfaces which are integrally formed on a first optical member of an optical integrator;

introducing a radiation from the first minute refraction surfaces to a plurality of second minute refraction surfaces which are integrally formed on a second optical member of the optical integrator, and which optically correspond to the plurality of first minute refraction surfaces;

illuminating a pattern with a radiation from the optical integrator; and

projecting a pattern image on a photosensitive substrate while moving the photosensitive substrate along a scanning direction,

wherein the first optical member and the second optical member are separated by a space, that is filled with a gas, and

wherein a refraction index of an optical material forming the second optical member is set larger than a refraction index of an optical material forming the first optical member.

53.   (Previously Presented) A device manufacturing method comprising:

exposing a photosensitive substrate with the exposure method according to claim 52; and

developing the photosensitive substrate.

54.   (Previously Presented) A method of manufacturing an optical integrator comprising:

integrally forming a plurality of first minute refraction surfaces on the optical integrator; and

integrally forming a plurality of second minute refraction surfaces on the optical integrator, the second minute refraction surfaces optically corresponding to the plurality of first minute refraction surfaces,

wherein a parameter β satisfies the following conditions:

$|\beta| < 0.2$ (where $\beta = (\gamma -1)^3 \cdot NA^2/\Delta n^2$),

where a refracting power ratio $\varphi a/\varphi b$ between φa, a refracting power of the first minute refraction surfaces in terms of a non-scanning direction optically approximately perpendicular to the scanning direction and φb, a refracting power of the second minute refraction surfaces in terms of the non-scanning direction is γ, a numerical aperture on the emission side in terms of the non-scanning direction of the optical integrator is NA, and a difference between a refraction index of a medium on a light entrance side of the second minute refraction surfaces and a refraction index of a medium on a light emission side of the second minute refraction surfaces is Δn.

55.   (Previously Presented) The method according to claim 54, wherein the plurality of first minute refraction surfaces are formed on a first member of the optical integrator, and wherein the plurality of first minute refraction surfaces are formed on a second member of the optical integrator.

56.   (Previously Presented) The method according to claim 55, further comprising:

arranging the first member and the second member separately from each other.

57.   (Previously Presented) An optical integrator manufactured by the method according to claim 54.

58.   (Currently Amended) A method of manufacturing an optical integrator comprising:

integrally forming a plurality of first minute refraction surfaces on a first optical member of the optical integrator;

integrally forming a plurality of second minute refraction surfaces on a second optical member of the optical integrator, the second minute refraction surfaces optically corresponding to the plurality of first minute refraction surfaces; and

arranging the first optical member and the second optical member separately from each other, with a gas-filled space between the first and second optical members,

wherein a refraction index of an optical material forming the second optical member is set larger than a refraction index of an optical material forming the first optical member.

59.   (Previously Presented) An optical integrator manufactured by the method according to claim 58.